DMOS+
Gen4 DMOS

DIM1500ESM33-RR500

Single Switch IGBT Module

DS6446-1 July 2024 (LN43468)

FEATURES

- 10µs Short Circuit Withstand
- High Thermal Cycling Capability
- High Current Density Enhanced DMOS
- Isolated AlSiC Base With AlN Substrates
- Low Switching Loss Device

APPLICATIONS

- High Reliability Inverters
- Motor Controllers
- Smart Grid
- Traction Drives

The Powerline range of high-power modules includes half bridge, chopper, dual, single and bi-directional switch configurations covering voltages from 1200V to 6500V and currents up to 2400A.

The DIM1500ESM33-RR500 is a single switch 3300V, n-channel enhancement mode, insulated gate bipolar transistor (IGBT) module. The IGBT has a wide reverse bias safe operating area (RBSOA) plus 10µs short circuit withstand. This device is optimised for traction drives and other applications requiring high thermal cycling capability.

The module incorporates an electrically isolated base plate and low inductance construction enabling circuit designers to optimise circuit layouts and utilise grounded heat sinks for safety.

ORDERING INFORMATION

Order As:

DIM1500ESM33-RR500

Note: When ordering, please use the complete part number

KEY PARAMETERS

V_{CES}		**3300V**
$V_{CE(sat)}$ *	**(typ)**	**2.6V**
I_C	**(max)**	**1500A**
$I_{C(PK)}$	**(max)**	**3000A**

* Measured at the auxiliary terminals

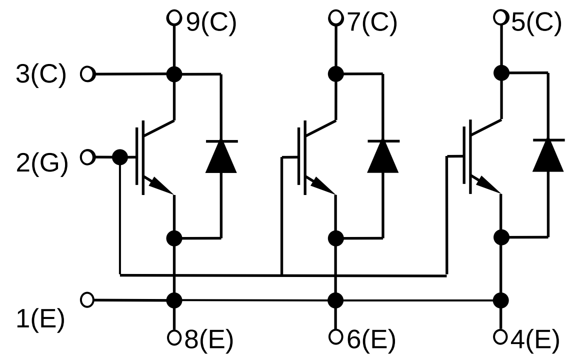


Fig. 1 Circuit configuration

Outline type code: E

(See Fig. 11 for further information)

Fig. 2 Package

ABSOLUTE MAXIMUM RATINGS

Stresses above those listed under 'Absolute Maximum Ratings' may cause permanent damage to the device. In extreme conditions, as with all semiconductors, this may include potentially hazardous rupture of the package. Appropriate safety precautions should always be followed. Exposure to Absolute Maximum Ratings may affect device reliability.

T_{case} = 25°C unless stated otherwise

Symbol	Parameter	Test Conditions	Max.	Units
V_{CES}	Collector-emitter voltage	V_{GE} = 0V	3300	V
V_{GES}	Gate-emitter voltage		±20	V
I_C	Continuous collector current	T_{case} = 95°C	1500	A
$I_{C(PK)}$	Peak collector current	1ms,	3000	A
P_{max}	Max. transistor power dissipation	T_{case} = 25°C, T_j = 150°C	14.8	kW
I^2t	Diode I^2t value	V_R = 0, t_p = 10ms, T_j = 150°C	720	kA^2s
V_{isol}	Isolation voltage – per module	Commoned terminals to base plate. AC RMS, 1 min, 50Hz	6000	V
Q_{PD}	Partial discharge – per module	IEC1287, V_1 = 3500V, V_2 = 2600V, 50Hz RMS	10	pC

THERMAL AND MECHANICAL RATINGS

Internal insulation material:	AlN
Baseplate material:	AlSiC
Creepage distance – terminal to heatsink:	33mm
Creepage distance – terminal to terminal:	34mm
Clearance – terminal to heatsink:	20mm
Clearance – terminal to terminal:	20mm
CTI (Comparative Tracking Index):	>600

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Units
$R_{th(j-c)}$	Thermal resistance – transistor	Continuous dissipation - junction to case	-	-	8.4	°C/kW
$R_{th(j-c)}$	Thermal resistance – diode	Continuous dissipation - junction to case	-	-	12.8	°C/kW
$R_{th(c-h)}$	Thermal resistance – case to heatsink (per module)	Mounting torque 5Nm (with mounting grease, 1W/mK)	-	6	-	°C/kW
T_j	Junction temperature	Transistor	-40	-	150	°C
		Diode	-40	-	150	°C
T_{stg}	Storage temperature range	-	-40	-	150	°C
	Screw torque	Mounting – M6	-	-	5	Nm
		Electrical connections – M4	-	-	2	Nm
		Electrical connections – M8	-	-	10	Nm

ELECTRICAL CHARACTERISTICS

T_{case} = 25°C unless stated otherwise.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
I_{CES}	Collector cut-off current	V_{GE} = 0V, V_{CE} = V_{CES}			1	mA
		V_{GE} = 0V, V_{CE} = V_{CES}, T_{case} = 125°C			90	mA
		V_{GE} = 0V, V_{CE} = V_{CES}, T_{case} = 150°C			150	mA
I_{GES}	Gate leakage current	V_{GE} = ± 20V, V_{CE} = 0V			1	μA
$V_{GE(TH)}$	Gate threshold voltage	I_C = 120mA, V_{GE} = V_{CE}	5.40	6.00	6.60	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15V, I_C = 1500A		2.60	3.00	V
		V_{GE} = 15V, I_C = 1500A, T_j = 125°C		3.15		V
		V_{GE} = 15V, I_C = 1500A, T_j = 150°C		3.30		V
I_F	Diode forward current	DC		1500		A
I_{FM}	Diode maximum forward current	t_p = 1ms		3000		A
V_F	Diode forward voltage	I_F = 1500A		2.00	2.40	V
		I_F = 1500A, T_j = 125°C		2.15		V
		I_F = 1500A, T_j = 150°C		2.15		V
C_{ies}	Input capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 100kHz		158		nF
Q_g	Gate charge	±15V		14		μC
C_{res}	Reverse transfer capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 100kHz		3.7		nF
L_{sCE}	Module stray inductance			5		nH
$R_{CC'+EE'}$	Module lead resistance, terminal - chip			140		μΩ
SC_{Data}	Short circuit current, I_{SC}	T_j = 150°C, V_{CC} = 2500V t_p ≤ 10μs, V_{GE} ≤ 15V $V_{CE\ (max)}$ = V_{CES} – L^* x di/dt IEC 60747-9		6700		A

Note:

* L is the circuit inductance + L_M

ELECTRICAL CHARACTERISTICS

T_{case} = 25°C unless stated otherwise

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Units
$t_{d(off)}$	Turn-off delay time	I_C = 1500A V_{GE} = ±15V V_{CE} = 1800V $R_{g(ON)}$ = 1.0Ω $R_{g(OFF)}$ = 1.5Ω C_{GE} = 330nF L_S ~ 180nH		2450		ns
t_f	Fall time			1300		ns
E_{OFF}	Turn-off energy loss			2365		mJ
$t_{d(on)}$	Turn-on delay time			550		ns
t_r	Rise time			355		ns
E_{ON}	Turn-on energy loss			1360		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 1500A V_{CE} = 1800V		1130		μC
I_{rr}	Diode reverse recovery current			1460		A
E_{rec}	Diode reverse recovery energy			1490		mJ

T_{case} = 125°C unless stated otherwise

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Units
$t_{d(off)}$	Turn-off delay time	I_C = 1500A V_{GE} = ±15V V_{CE} = 1800V $R_{g(ON)}$ = 1.0Ω $R_{g(OFF)}$ = 1.5Ω C_{GE} = 330nF L_S ~ 180nH		2530		ns
t_f	Fall time			2050		ns
E_{OFF}	Turn-off energy loss			2930		mJ
$t_{d(on)}$	Turn-on delay time			585		ns
t_r	Rise time			363		ns
E_{ON}	Turn-on energy loss			1730		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 1500A V_{CE} = 1800V		1700		μC
I_{rr}	Diode reverse recovery current			1580		A
E_{rec}	Diode reverse recovery energy			2310		mJ

T_{case} = 150°C unless stated otherwise

Symbol	Parameter	Test Conditions		Min	Typ.	Max	Units
$t_{d(off)}$	Turn-off delay time	I_C = 1500A V_{GE} = ±15V V_{CE} = 1800V $R_{g(ON)}$ = 1.0Ω $R_{g(OFF)}$ = 1.5Ω C_{GE} = 330nF L_S ~ 180nH	d_v/d_t = 4700V/μs		2550		ns
t_f	Fall time				2260		ns
E_{OFF}	Turn-off energy loss				3100		mJ
$t_{d(on)}$	Turn-on delay time		d_i/d_t = 3700A/μs		585		ns
t_r	Rise time				370		ns
E_{ON}	Turn-on energy loss				2000		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 1500A V_{CE} = 1800V dI_F/dt = 3700A/μs			1950		μC
I_{rr}	Diode reverse recovery current				1660		A
E_{rec}	Diode reverse recovery energy				2700		mJ

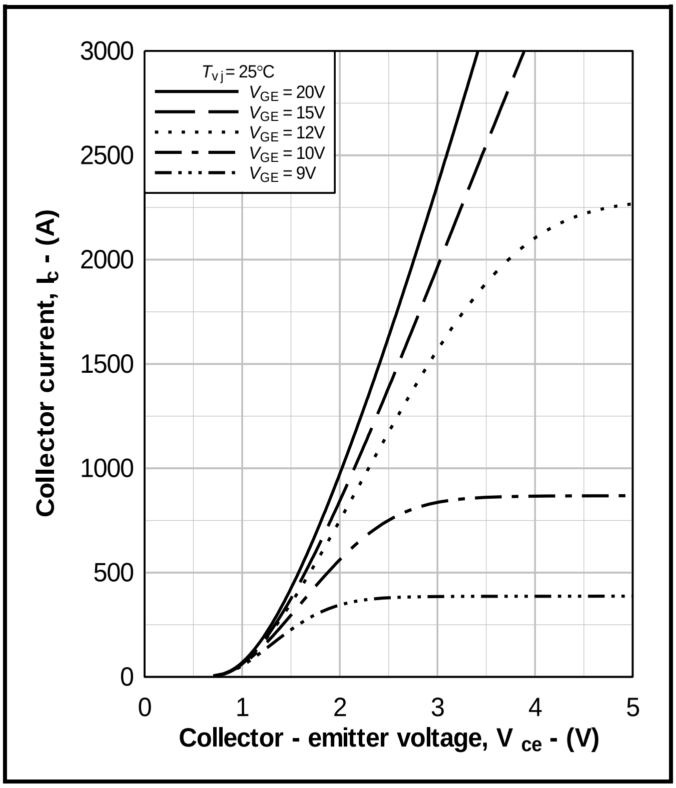


Fig. 3 Typical IGBT output characteristics

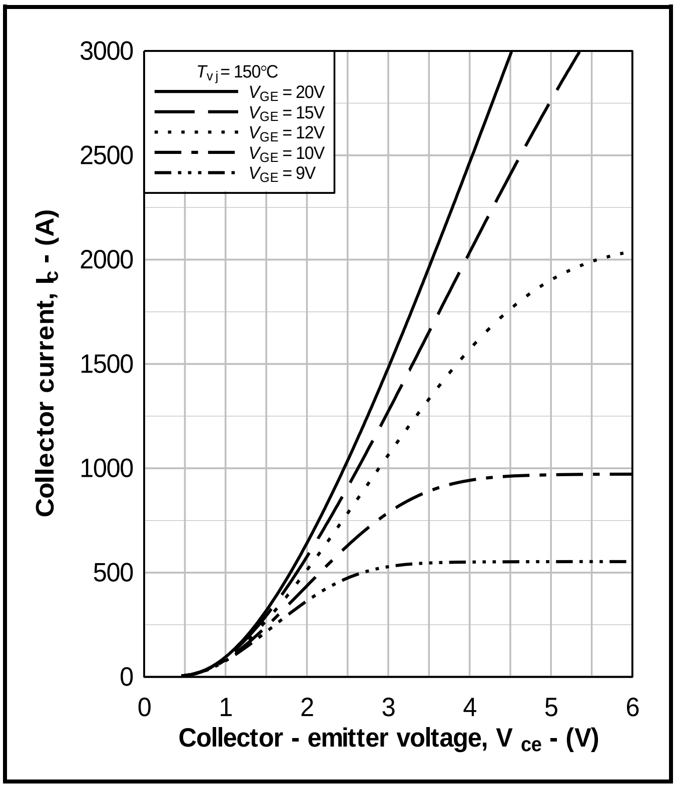


Fig. 4 Typical IGBT output characteristics

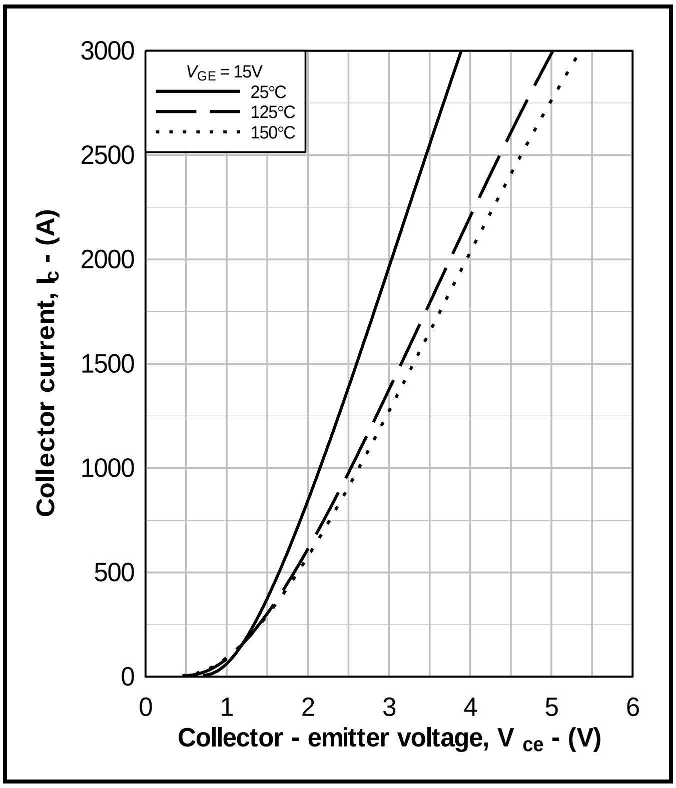


Fig. 5 Typical IGBT output characteristics, $I_C = f(V_{CE})$

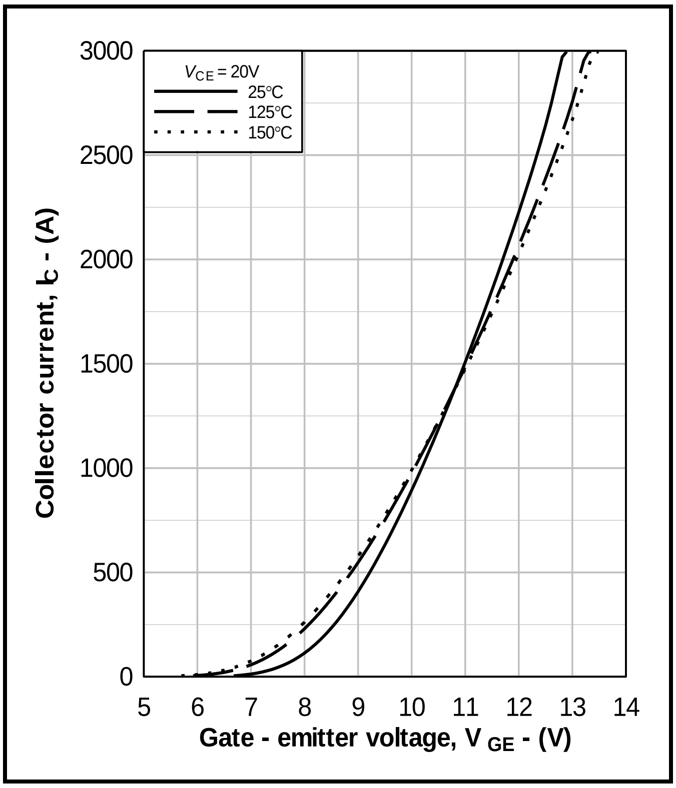


Fig. 6 Typical IGBT transfer characteristics, $I_C = f(V_{GE})$

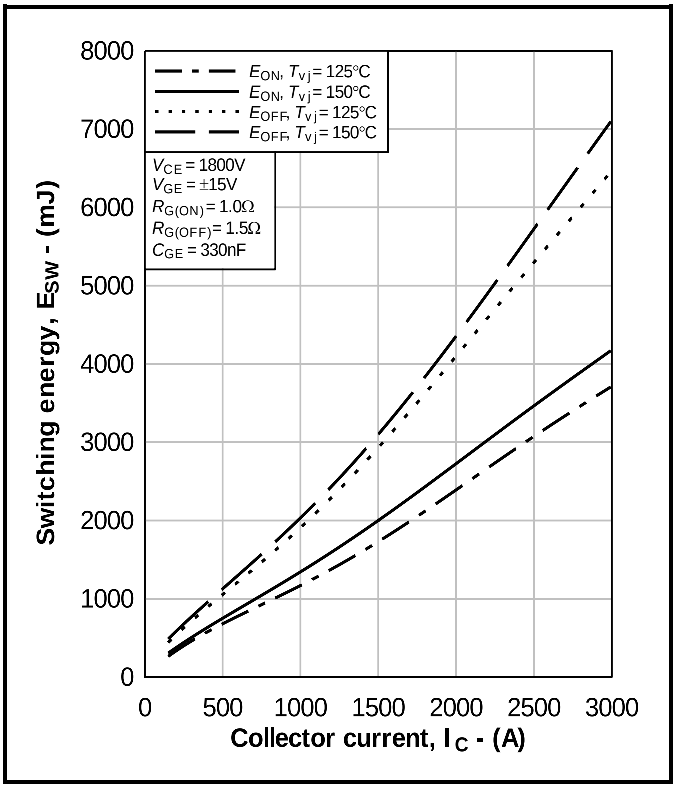


Fig. 7 Typical IGBT switching energy, E_{ON} = f(I_C), E_{OFF} = f(I_C)

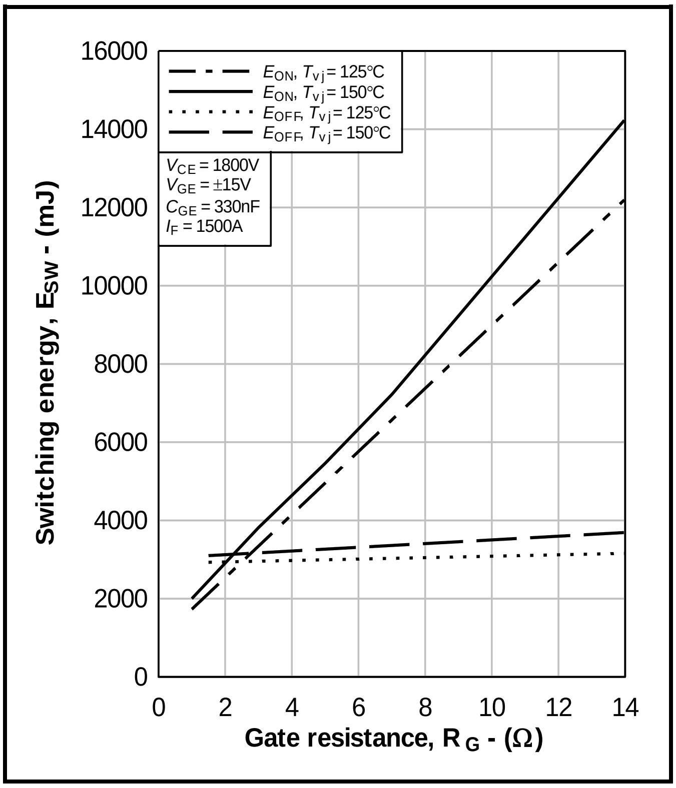


Fig. 8 Typical IGBT switching energy E_{ON} = f(R_G), E_{OFF} = fR_G)

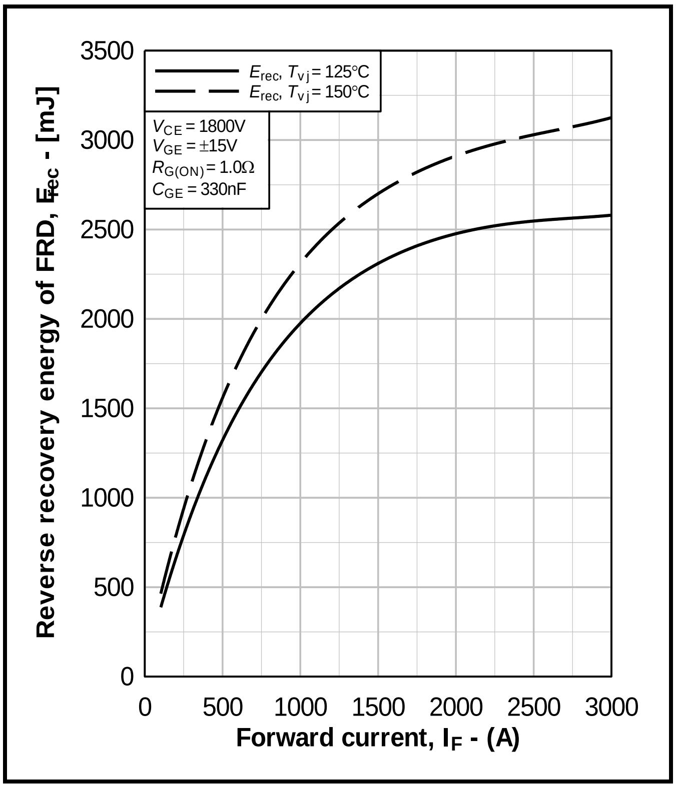


Fig. 9 Typical FRD E_{rec}, E_{rec} = f(I_F)

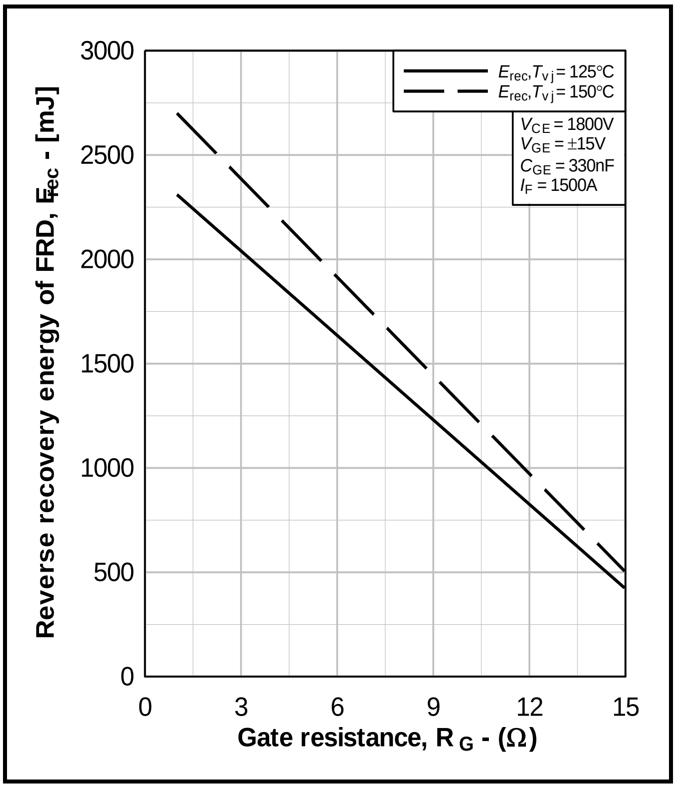


Fig. 10 Typical FRD E_{rec}, E_{rec} = f(R_G)

Caution: This device is sensitive to electrostatic discharge. Users should follow ESD handling procedures.

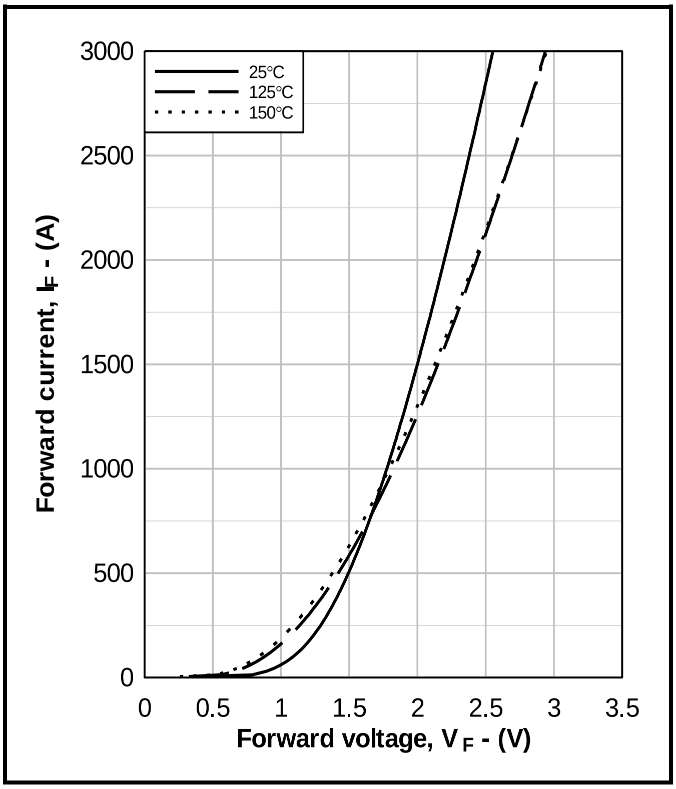


Fig. 11 Typical FRD output characteristics, $I_F = f(V_F)$

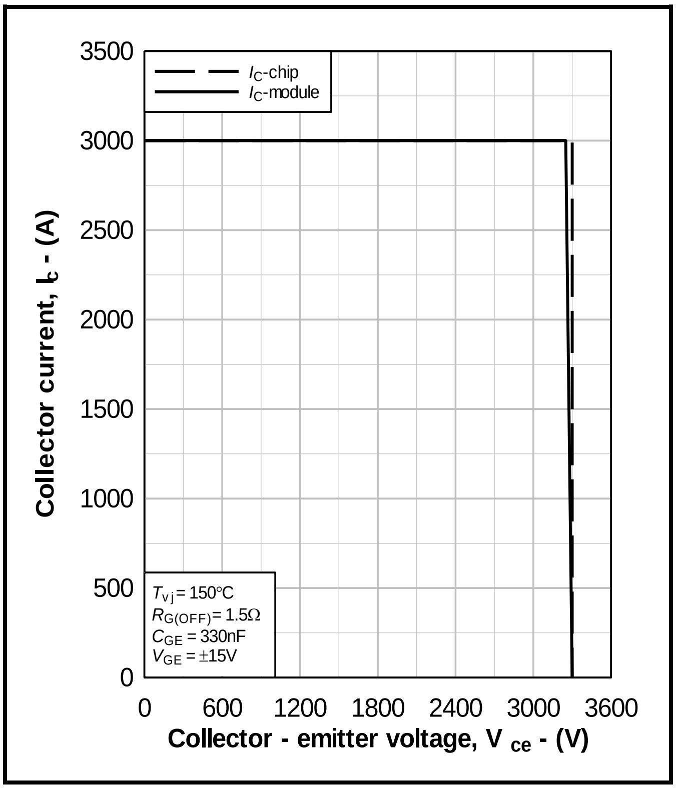


Fig. 12 Reverse bias safe operating area of IGBT, $I_C = f(V_{CE})$

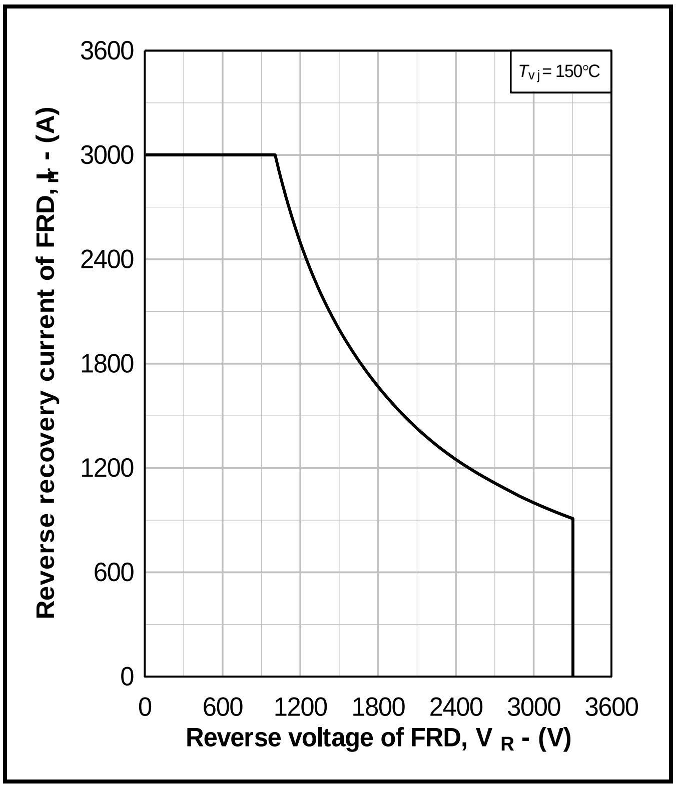


Fig. 13 Diode reverse bias safe operating area

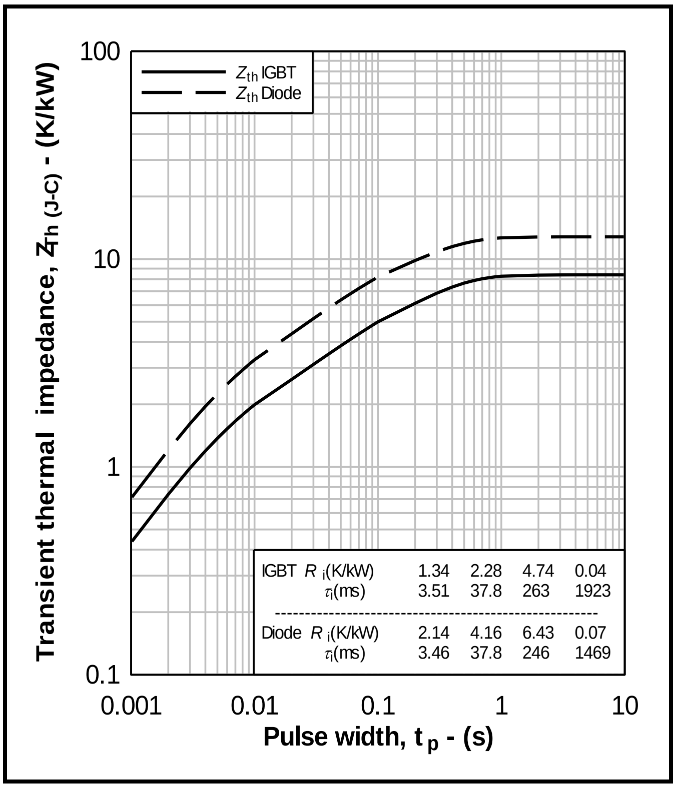


Fig. 14 Transient thermal impedance, $Z_{th}(J\text{-}C) = f(t)$

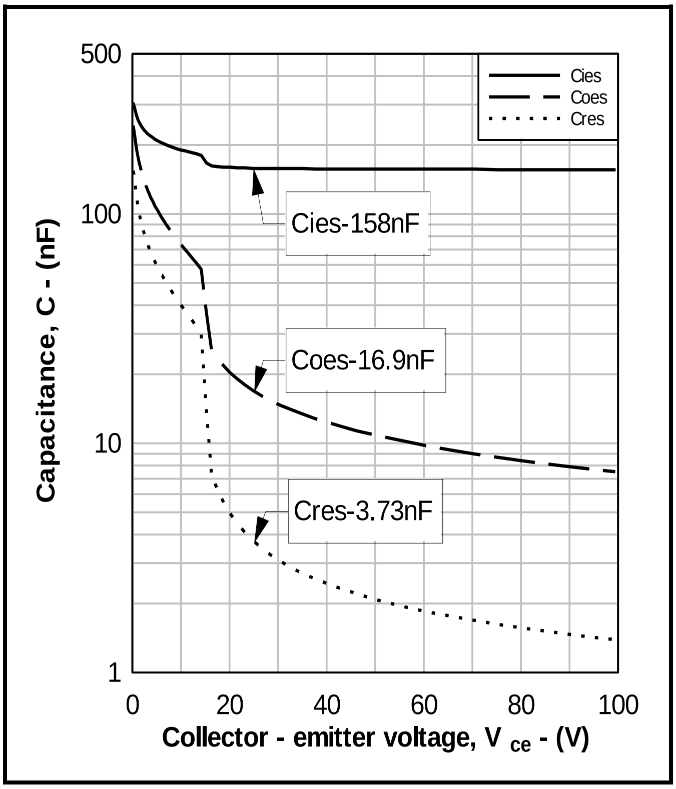


Fig. 15 Typical capacitor characteristic, C = f (V_{CE})

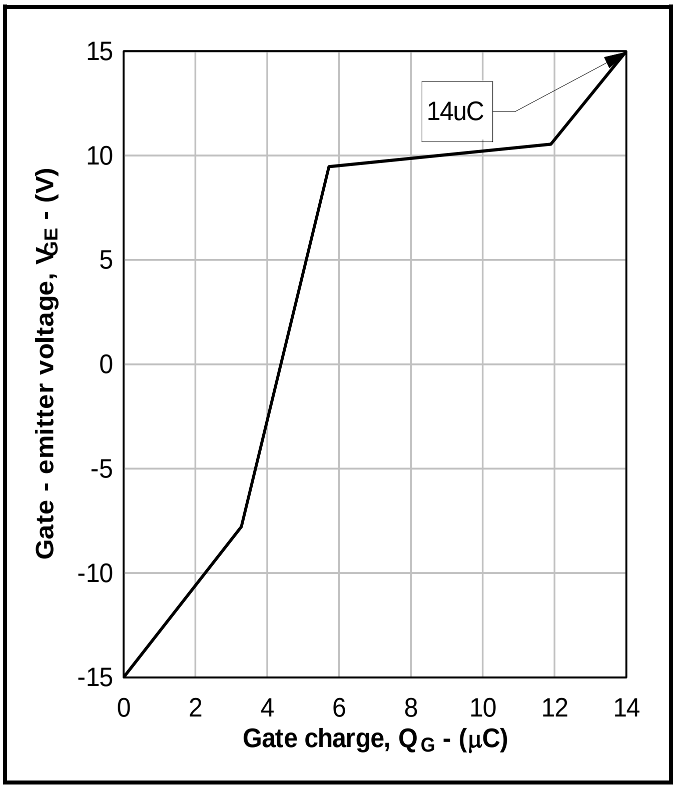
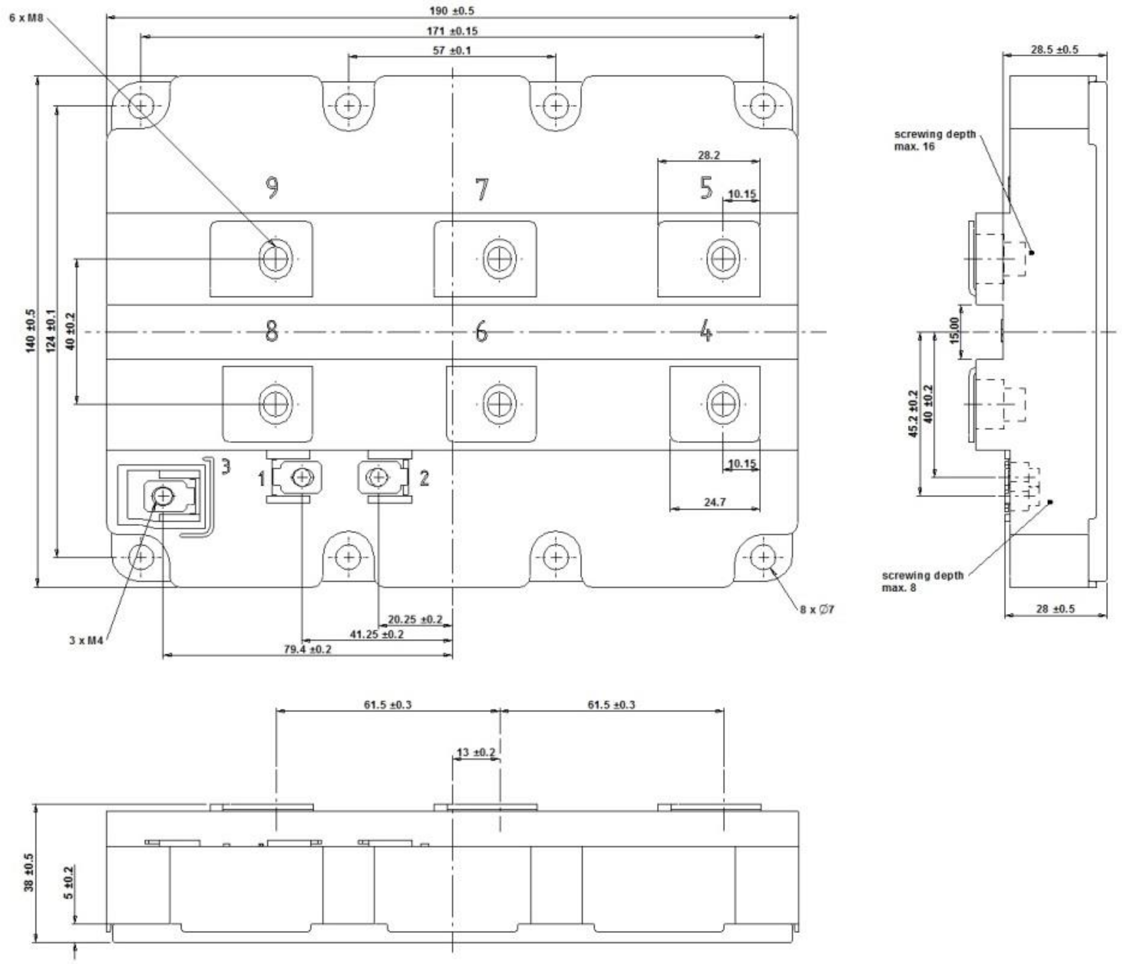


Fig. 16 Typical gate charge characteristic, V_{GE} = f (Q_G)

Caution: This device is sensitive to electrostatic discharge. Users should follow ESD handling procedures.

PACKAGE DETAILS

For further package information, please visit our website or contact Customer Services.
All dimensions in mm, unless stated otherwise.
DO NOT SCALE.



Nominal Weight: 1100g

Module Outline Type Code: E

Fig. 17 Module outline drawing

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Extended exposure to conditions outside the product ratings may affect reliability leading to premature product failure. Use outside the product ratings is likely to cause permanent damage to the product. In extreme conditions, as with all semiconductors, this may include potentially hazardous rupture, a large current to flow or high voltage arcing, resulting in fire or explosion. Appropriate application design and safety precautions should always be followed to protect persons and property.

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